

CLAIMS

Having thus described the preferred embodiments, the invention is now claimed to be:

1. A system for recirculating fluids, the system comprising:
a storage drum containing a semiconductor slurry; and
~~an~~An apparatus, including comprising:
a base portion;
an inlet portion coupled to a first end of the base portion, the inlet portion being in fluid communication with the storage drum and configured to receive the semiconductor slurry from the storage drum; and
a nozzle coupled to a second end of the base portion and located to recirculate the semiconductor slurry into the storage drum, the nozzle comprising:
a nozzle base portion;
a nozzle inlet at a first end of the nozzle base portion; and
a nozzle portion that extends away from an exterior surface of the nozzle base portion between the first end and a second end of the nozzle base portion,
wherein the nozzle portion comprises a helical groove extending from a position near the nozzle base portion to a position near a tip of the nozzle portion.
2. The ~~system~~apparatus of claim 1, wherein the base portion comprises:
a first portion;
a second portion coupled to the first portion, wherein the first portion is at an angle with respect to the second portion.
3. The ~~system~~apparatus of claim 2, wherein the angle of the first portion with respect to the second portion is between 90 degrees and 160 degrees.
4. The ~~system~~apparatus of claim 2, wherein the base portion further comprises:
a connector coupled to the first portion on a first end and the second portion on a second end.
5. The ~~system~~apparatus of claim 4, wherein the base portion is angled at the connector.

6. The ~~system~~apparatus of claim 2, wherein the inlet portion comprises:
a first inlet portion;
a second inlet portion; and
an inlet connector with a first end and a second end, wherein the first end is received within the first inlet portion and the second end is received within the second inlet portion to couple the first inlet portion to the second inlet portion.

7. The ~~system~~apparatus of claim 6, wherein the first inlet portion is tapered from a first end to a second end.

8. The ~~system~~apparatus of claim 6, wherein the inlet connector has an outer diameter smaller than an outer diameter of the first inlet portion and an outer diameter of the second inlet portion.

~~9. The apparatus of claim 6, wherein the nozzle comprises:
a nozzle base portion;
a nozzle inlet at a first end of the base portion; and
a nozzle portion that extends away from an exterior surface of the nozzle base portion between the first end and a second end of the nozzle base portion.~~

~~10.9.~~ The ~~system~~apparatus of claim ~~19~~, wherein the nozzle portion tapers as it extends away from the second end of the nozzle base portion to a tip.

~~11. The apparatus of claim 9, wherein the nozzle portion comprises:
a helical groove extending from a position near the nozzle base portion to a position near the tip of the nozzle portion.~~

~~12.10.~~ The ~~system~~apparatus of claim ~~14~~, wherein the helical groove extends from an exterior surface through the nozzle portion to an interior surface of the nozzle portion.

~~13.11.~~ The ~~system~~apparatus of claim ~~24~~, further comprising:
a coupler coupled to ~~at~~ the second inlet portion on a first end and the first portion of the base portion on a second end.

~~14.12.~~ The ~~system~~apparatus of claim ~~113~~, wherein the coupler comprises:

a first coupler portion;
a second coupler portion; and
a connector with a first end and a second end, wherein the first end is received within the first coupler portion and the second end is received within the second coupler portion to couple the first coupler portion to the second coupler portion.

15. — ~~A method of using an apparatus, comprising:~~

~~coupling a first apparatus to a semiconductor recirculation system, wherein the first apparatus comprises:~~

~~a first base portion;~~

~~a first inlet portion coupled to a first end of the first base portion; and~~

~~a first nozzle coupled to a second end of the first base portion, wherein the first nozzle includes a helical groove; and~~

~~passing a slurry through the first base portion of the first apparatus and out of the first nozzle into a storage container.~~

16. — ~~The method of claim 15, wherein the semiconductor recirculation system comprises:~~

~~a storage container for holding the slurry;~~

~~a recirculation loop including a fluid line; and~~

~~a pump for pumping the slurry out of the storage container, through the fluid line and the first nozzle and back into the storage container to mix the slurry.~~

17. — ~~The method of claim 16, wherein the first nozzle is tapered between a nozzle base portion and a nozzle tip.~~

18. — ~~The method of claim 15, wherein the helical groove extends from an exterior surface through the first nozzle to an interior surface.~~

19. — ~~The method of claim 18, further comprising:~~

~~taking periodic samples of the slurry from the fluid line in the recirculation loop using a sample valve.~~

20. — ~~The method of claim 18, further comprising:~~

monitoring the flow pressure of the slurry in the fluid line with a pressure gauge;
and
monitoring the volumetric flow rate using a rotameter.

21. — ~~The method of claim 16, wherein the storage container is a day tank; and wherein the recirculation system is coupled to the day tank and the first nozzle is positioned inside of the day tank.~~

22. — ~~The method of claim 21, comprising:
at least one second apparatus, wherein the at least one second apparatus comprises:~~

~~a second base portion;
a second inlet portion coupled to a first end of the second base portion;
and
a second nozzle coupled to a second end of the second base portion;
wherein the nozzle includes a helical groove.~~

23. — ~~The method of claim 22, wherein the at least one second apparatus is coupled to the recirculation system; wherein the second nozzle is positioned inside of the day tank; and wherein the second nozzle is spaced apart radially from the first nozzle.~~

24. — ~~An apparatus, comprising:
a base portion;
an inlet portion coupled to a first end of the base portion; and
a nozzle coupled to a second end of the base portion.~~

25. — ~~The apparatus of claim 24, wherein the base portion comprises:
a first portion;
a second portion coupled to the first portion, wherein the first portion is at an angle with respect to the second portion.~~

26. — ~~The apparatus of claim 25, wherein the angle of the first portion with respect to the second portion is between 90 degrees and 160 degrees.~~

27. — The apparatus of any of the preceding claims 24-26, wherein the base portion further comprises:

a connector coupled to the first portion on a first end and the second portion on a second end.

28. — The apparatus of any of the preceding claims 24-27, wherein the base portion is angled at the connector.

29. — The apparatus of any of the preceding claims 24-28, wherein the inlet portion comprises:

a first inlet portion;

a second inlet portion; and

an inlet connector with a first end and a second end, wherein the first end is received within the first inlet portion and the second end is received within the second inlet portion to couple the first inlet portion to the second inlet portion.

30. — The apparatus of any of the preceding claims 24-29, wherein the first inlet portion is tapered from a first end to a second end.

31. — The apparatus of any of the preceding claims 24-30, wherein the inlet connector has an outer diameter smaller than an outer diameter of the first inlet portion and an outer diameter of the second inlet portion.

32. — The apparatus of any of the preceding claims 24-31, wherein the nozzle comprises:

a nozzle base portion;

a nozzle inlet at a first end of the base portion; and

a nozzle portion that extends away from an exterior surface of the nozzle base portion between the first end and a second end of the nozzle base portion.

33. — The apparatus of any of the preceding claims 24-32, wherein the nozzle portion tapers as it extends away from the second base portion to a tip.

34. — The apparatus of any of the preceding claims 24-33, wherein the nozzle portion comprises:

a helical groove extending from a position near the nozzle base portion to a position near the tip of the nozzle portion.

35. — ~~The apparatus of any of the preceding claims 24-34, wherein the helical groove extends from an exterior surface through the nozzle portion to an interior surface of the nozzle portion.~~

36. — ~~The apparatus of any of the preceding claims 24-35, further comprising:~~

~~a coupler coupled to the second inlet portion on a first end and the first portion of the base portion on a second end.~~

37. — ~~The apparatus of any of the preceding claims 24-36, wherein the coupler comprises:~~

~~a first coupler portion;~~

~~a second coupler portion; and~~

~~a connector with a first end and a second end, wherein the first end is received within the first coupler portion and the second end is received within the second coupler portion to couple the first coupler portion to the second coupler portion.~~

38. — ~~A method of using an apparatus, comprising:~~

~~coupling a first apparatus to a semiconductor recirculation system, wherein the first apparatus comprises:~~

~~a first base portion;~~

~~a first inlet portion coupled to a first end of the first base portion; and~~

~~a first nozzle coupled to a second end of the first base portion, wherein the first nozzle includes a helical groove; and~~

~~passing a slurry through the first base portion of the first apparatus and out of the first nozzle into a storage container.~~

39. — ~~The method of claim 38, wherein the semiconductor recirculation system comprises:~~

~~a storage container for holding the slurry;~~

~~a recirculation loop including a fluid line; and~~

~~a pump for pumping the slurry out of the storage container, through the fluid line and the first nozzle and back into the storage container to mix the slurry.~~

40. — ~~The method of any of the preceding claims 38-39, wherein the first nozzle is tapered between a nozzle base portion and a nozzle tip.~~

41. — ~~The method of any of the preceding claims 38-40, wherein the helical groove extends from an exterior surface through the first nozzle to an interior surface.~~

42. — ~~The method of any of the preceding claims 38-41, further comprising:
taking periodic samples of the slurry from the fluid line in the recirculation loop using a sample valve.~~

43. — ~~The method of any of the preceding claims 38-42, further comprising:
monitoring the flow pressure of the slurry in the fluid line with a pressure gauge;
and
monitoring the volumetric flow rate using a rotameter.~~

44. — ~~The method of any of the preceding claims 38-43, wherein the storage container is a day tank; and wherein the recirculation system is coupled to the day tank and the first nozzle is positioned inside of the day tank.~~

45. — ~~The method of any of the preceding claims 38-44, comprising:
at least one second apparatus, wherein the at least one second apparatus comprises:~~

~~a second base portion;
a second inlet portion coupled to a first end of the second base portion;
and
a second nozzle coupled to a second end of the second base portion,
wherein the nozzle includes a helical groove.~~

46. — ~~The method of any of the preceding claims 38-45, wherein the at least one second apparatus is coupled to the recirculation system; wherein the second nozzle is positioned inside of the day tank; and wherein the second nozzle is spaced apart radially from the first nozzle.~~